Journal of Advanced Research in Applied Sciences and Engineering Technology

Journal homepage:
https://semarakilmu.com.my/journals/index.php/applied_sciences_eng_tech/index
ISSN: 2462-1943

Technological Innovations in Enhancing Digital Mental Health Engagement for Low-Income Groups

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ABSTRACT

Malaysia, classified as a low-income group, faces a significant burden of mental health problems. Digital Mental Health Interventions (DMHI) offer innovative solutions to address mental disorders (MD) through the application of scientific principles and engineering technologies. This study investigates the digital mental health (DMH) tools used to prevent MD and identifies the factors influencing their adoption among low-income groups (LIG). This study reviews four key articles that highlight three main DMH tools: Mobile Health (mHealth), telehealth, social media platforms, and chatbots. It identifies key factors driving engagement with DMH tools among LIG, including accessibility, communication, affordability, cultural sensitivity, and government policies. Advances in technology are enhancing the accessibility and effectiveness of DMH tools, making them increasingly viable for LIG. By leveraging applied science and engineering technologies, these tools can reduce the cost of mental health care, improve service utilization, and alleviate the burden of mental disorders.

Keywords:
Digital mental health; engineering technology tools; scientific principles; prevention; mental disorder; low income

1. Introduction

Mental health illnesses are complex syndromes of the nervous or anxious system, characterized by behavioural or mental patterns that cause significant distress or impair personal functioning explained by World Economic Forum [1]. These conditions contribute significantly to the global burden of disease, encompassing anxiety, depression, bipolar disorder, schizophrenia, eating disorders, and post-traumatic stress disorder. The World Health Organization [2] reported that 13% of the global population, approximately 970 million people, had a mental health illness worldwide. It is estimated that mental health cases have increased, with one in fifteen years lived with disability due to mental health issues. Epidemiological studies in Europe indicate that the burden of mental illness has increased from 5.38% in 1990 to 7.44% in 2010, higher than diabetes, respiratory diseases, and musculoskeletal disorders, but similar to neoplasms enlightened by Murray *et al.,* [3].

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https://doi.org/10.37934/araset.59.1.209226

Access to mental health services remains limited despite the high prevalence of mental health issues. A qualitative study by Wang *et al.,* [4] identified numerous barriers to seeking mental health care, including low income, financial constraints, lack of awareness about available services, and societal stigma. These barriers not only hinder timely diagnosis and treatment but also perpetuate stigma and discrimination against mental health issues. The impact of mental health illnesses on individuals, families, and communities in Malaysia has been gaining substantial attention. Despite improvements in healthcare infrastructure and awareness initiatives, mental health concerns remain significant in Malaysia. In Malaysia, cultural practices and beliefs heavily influence perceptions of mental health. A qualitative study by Wong and Awang [5] found that traditional beliefs, such as supernatural influences or perceptions of human weakness, often deter individuals from seeking treatment. Nationwide research by the Ministry of Health Malaysia [6] estimated that the prevalence of mental health problems among adults is approximately 29.2%, with anxiety and depression being the most common conditions. Teenagers and young people in Malaysia are especially susceptible to mental health problems, with approximately 14% of adolescents experiencing significant psychological distress described by Mat Ruzlin *et al.,* [7].

Digital Mental Health Interventions (DMHIs) encompass various technologies and applications designed to provide mental health care and support through digital platforms. These interventions leverage scientific principles and engineering technologies to offer innovative solutions for mental health care, including mobile health (mHealth) applications, telehealth services, and AI-powered chatbots. DMHIs offer several potential benefits, including increased accessibility, reduced costs, and the ability to reach underserved populations. These technologies can overcome some of the barriers associated with traditional mental health services, such as stigma, cost, and limited availability of mental health professionals. Digital health tools have proven efficient and accessible, with benefits in both cost and patient outcomes, especially during the COVID-19 pandemic found by Monaghesh and Hajizaden [8].

Low-income groups face unique challenges in accessing mental health care, including financial constraints, lack of digital literacy, and cultural barriers. These challenges are particularly pronounced in low-income settings, including Malaysia. Low-income and middle-income countries are highly affected by mental health disorders compared to high-income countries due to the substantial mental health gap explained by Fu *et al.,* [9]. Available services of digital mental health in low-income groups should be strengthened to avoid serious mental health illnesses and address numerous social challenges such as sexual abuse, stigma and discrimination, intimate partner violence, and poverty clarified by Latha *et al.,* [10]. Mobile health (mHealth) technologies include applications designed for mental health, such as mental health apps and SMS-based interventions. These tools provide features like mood tracking, cognitive-behavioural therapy (CBT) exercises, and psychoeducation. For instance, the app "MoodTools" helps users manage depression through CBT techniques and thought diaries explained by Firth *et al.,* [11].

Telehealth and telepsychiatry offer remote mental health services, providing timely access to evidence-based treatments while mitigating barriers such as transportation costs and time constraints. Telehealth has been shown to be effective and cost-efficient, particularly in low-income settings. Social media platforms and AI-powered chatbots are increasingly used in mental health interventions. These tools can engage users and provide real-time support. Chatbots powered by AI algorithms offer 24/7 support and cognitive behavioural techniques, while AI-driven predictive analytics optimize intervention strategies explained by Fitzpatrick *et al.,* [12]. Accessibility is crucial for the success of DMH tools, particularly for low-income groups. Affordable devices and internet services are necessary to ensure widespread adoption. Effective communication, including the use of local languages and culturally appropriate messaging, is essential for the success of DMH

interventions. Affordability plays a significant role in the adoption of DMH tools. Technological innovations can reduce the cost of mental health care, making it more accessible to low-income populations. Culturally sensitive approaches are necessary in designing and implementing DMH interventions to ensure they are relevant and acceptable to the target population. Supportive government policies can promote the adoption and sustainability of DMH tools. Policy frameworks that facilitate the integration of these technologies into the healthcare system are essential.

This study aims to investigate the types of DMH tools used, identify factors influencing the engagement, and assess their impact on low-income groups in Malaysia. The study will review key articles and focus on specific DMH tools such as mHealth, telehealth, social media platforms, and chatbots. This study will contribute to the existing body of knowledge on DMHIs, particularly in the context of low-income groups. The findings of this study will have practical implications for policymakers, healthcare providers, and technology developers, informing the design and implementation of effective DMH interventions for low-income populations. Technological innovations hold significant potential for enhancing digital mental health engagement, particularly among low-income groups who often face barriers to accessing traditional mental health services. The robust digital infrastructure in Malaysia, with high levels of internet access and smartphone usage, is crucial for the widespread adoption and utilization of digital mental health tools.

This study aims to address the mental health needs of low-income populations in Malaysia by exploring the utilization of DMH tools and the factors influencing their adoption. The evidence presented underscores the pervasive nature of mental health issues globally and highlights the urgent need for targeted interventions, particularly for low-income groups. Technological innovations in digital mental health can significantly enhance engagement and provide cost-effective, accessible mental health care solutions. This study's findings will contribute valuable insights into the effective implementation of DMH interventions in low-income settings, ultimately aiming to reduce the burden of mental health disorders in Malaysia and beyond.

2. Methodology

2.1 Literature Search and Search Strategy

An efficient search was conducted in electronic databases SCOPUS on systematic literature review and empirical studies that descripted using qualitative or quantitative data that published from year 2017 to 2023. All search is carried out in the same day (August 7, 2023) for daily update control. The keyword using for the search include the Digital Mental, Mental Disorder, Low-Income and Factor Influencing. Some of the term that have combination of two or three word, combined with AND search. The narrow search to target the inclusion criteria that includes all the primary aim in target articles and the appendix provides the search results. PRISMA guidelines are considered to minimize bias in meta-analyses and systematic reviews. PRISMA also helps researchers reduce the risk of introducing bias into their reviews through adhering to standardized methods for study selection, data extraction, and data synthesis. This is important for unbiased summaries of existing evidence and producing objective. By offering a standardized framework that enables other researchers to duplicate the review process and validate its outcomes, PRISMA promotes reproducibility.

Subsequently, PRISMA principles facilitate transparency and reproducibility by providing explicit documentation of the search strategy, research selection criteria, and data extraction techniques. This helps to build confidence in the validity of the review findings. PRISMA is distinct from other tools for systematic reviews since it is widely used and supported by prestigious publications and research organizations. Because of its strict methodology and emphasis on openness, researchers

wishing to perform excellent systematic reviews and meta-analyses choose to use it. In order to ensure thorough and organized reporting of study findings, PRISMA also provides a comprehensive checklist and flow diagram that led researchers through each step of the review process. Overall, using PRISMA improves our systematic review's legitimacy, openness, and repeatability, which eventually strengthens the impact and validity of our findings.

2.2 Inclusion Criteria

The inclusion criteria are essential in defining the study's scope and selecting the papers that meet the review's inclusion requirements in the context of this systematic review. The qualities that studies need to have in order to be deemed relevant to this research goals are outlined in the inclusion criteria. The idea behind inclusion criteria is to find papers that fit particular predetermined standards associated with the goals and research topic. This paper includes research on digital mental health interventions and the characteristics that promote the use of technology to prevent mental disorders from low-middle-income countries in the analysis. The World Bank Classification [13] is used to categories the nations included in the paper as low-middle income countries. The significance of inclusion criteria is rooted in their ability to guarantee that the chosen studies are in line with the research goals and make a significant contribution to the evidence synthesis. We can increase the relevance and applicability of our findings by concentrating our efforts on locating papers that address the important components of our research issue by precisely specifying the inclusion criteria.

2.3 Exclusion Criteria

On the other hand, the exclusion criteria specify the parameters that determine which research are not taken into account in the systematic review. By defining traits or qualities that make research ineligible for inclusion, exclusion criteria help to weed out irrelevant or improper investigations. Articles that did not address factors associated with low-income groups, engagement with digital mental health therapies or that did not concentrate on these interventions were not included in this analysis. Studies that failed to meet the English language requirement were also disqualified from consideration. The significance of exclusion criteria resides in their ability to preserve the systematic review's relevance and integrity. This study may make sure that the chosen studies are in line with the goals of the research and make a significant contribution to the synthesis of evidence by excluding studies that don't fit predetermined criteria.

2.4 Study Selection Process

The study selection process followed the PRISMA guidelines as referenced by Page *et al.,* [14]. Figure 1 illustrates the PRISMA diagram systematic process followed in the identification, screening, and selection of studies for inclusion in this research on Digital Mental Health Interventions in low-middle income countries. The process in identification begins with the identification of relevant studies from databases such as SCOPUS. Initially, n=2694 records were identified from the Scopus database through database searches. After removing n=589 duplicate records using Mendeley References Manager to ensure the integrity of dataset, the remaining n=2105 unique records were screened based on their titles and abstracts. Next, during the inclusion phase, articles were assessed to determine their relevance to the research topic and alignment with the inclusion criteria. Factors considered in the inclusion criteria included the focus on Digital Mental Health Interventions in low-middle income countries, the presence of factors encouraging the utilization of technology for mental

health, and publication in English. Following the inclusion criteria, n=42 articles remained for further consideration and n=5 articles not retrieved and n=37 papers remained for full-text evaluation to determine their eligibility for inclusion in the study.

Articles were then subjected to exclusion criteria to ensure the study's focus remained on digital interventions for mental health within low-income groups and relevant engagement factors. Articles not meeting the criteria were excluded, resulting in the removal of n=33 articles. Reasons for exclusion included n=15 articles did not include factor that encourage the engagement of e-mental health, n=13 articles did not include a digital engagement, n=3 articles included populations only from high-income countries and n=2 articles did not measure mental disorder problem. Upon thorough examination, n=4 publications were deemed eligible for inclusion in our research. These selected papers were chosen based on their alignment with the study criteria and objectives, ensuring their relevance and contribution to understanding e-mental health utilization among low-income groups. In conclusion, the systematic process of identification, inclusion, exclusion, and final selection led to the identification of n=4 papers that formed the basis of our research on Digital Mental Health Interventions in low and middle-income countries.

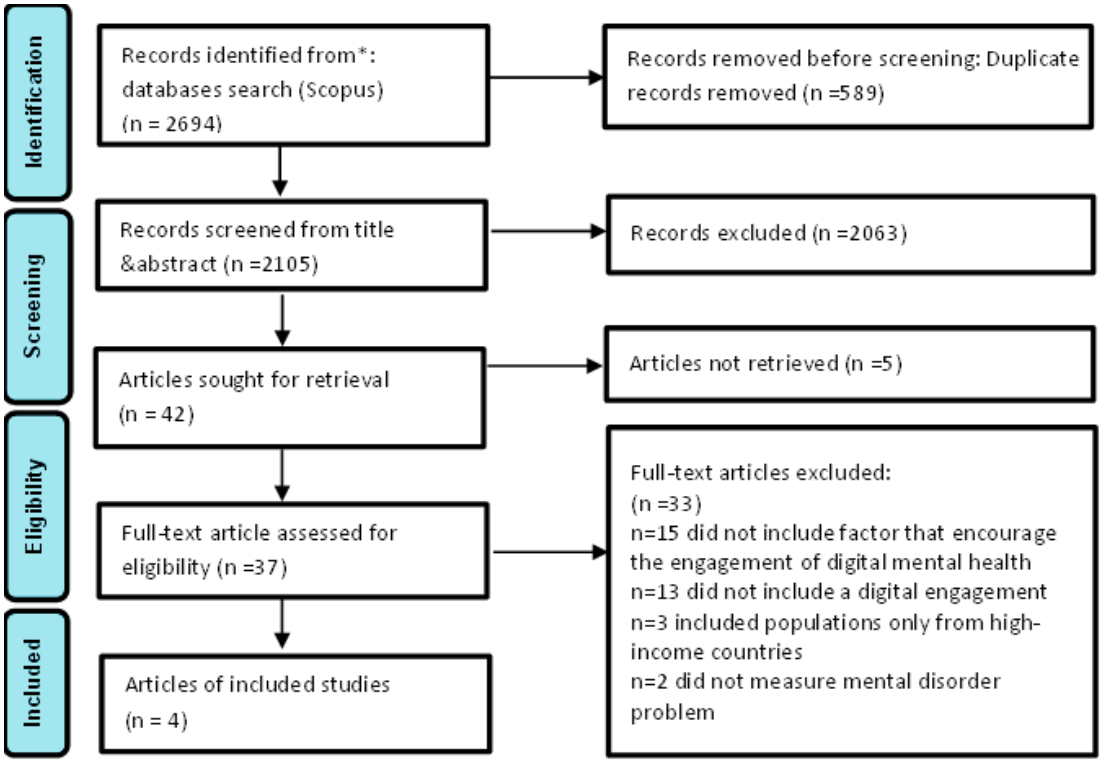

Fig. 1. Flow diagram of studies following PRISMA guidelines, 2020

3. Results

Table 1 provides a comprehensive summary extracted from each study, detailing the study characteristics, including country, target group, type of disorder, influencing factors, and the digital mental health (DMH) tools used for the main outcome measures. The studies cover nations classified as low-income according to the World Bank classification, and include one study focusing on the low-income population in the US. By examining these various applications of DMH tools, Table 1 highlights how these tools have been utilized to address mental health disorders such as depression, anxiety, schizophrenia, and general mental illness. Influencing factors like accessibility, affordability, communication, and cultural sensitivity are also considered, showcasing the diverse and effective use

of applied science and engineering technology in improving mental health outcomes for low-income populations globally.

Table 1
Data extraction from previous study

Study, author, year	Country	Group	Type of disorder	Influencing factors	DMH tools	Applied science perspective	Engineering technology perspective
Sultana and Pagan, 2023 [15]	US	US low-income population	Depressive Disorder Anxiety	Accessibility-easy access Communication-Bilingual	mHealth/ telehealth	Applies therapeutic frameworks such as CBT and psychodynamic therapy for remote consultations. Utilizes real-time analytics to assess and improve the quality of care provided	Utilizes cloud computing and encryption technologies for secure, real-time communication. Ensures data privacy and confidentiality through robust security measures.
Koly *et al.,* 2022 [16]	Bangladesh	low-income group	Various mental health issues	Accessibility Affordability	Social media platform	Leverages social support and community psychology principles to foster peer support and mental health awareness. Uses psychological theories to create impactful mental health campaigns.	Implements data analytics to measure engagement and track the impact of mental health interventions. Utilizes platform algorithms to identify and address mental health concerns in real-time.
Naslund *et al.,* 2017 [17]	India, Malaysia, South, Africa, China, Argentina, Chile, Columbia Mexico, Spain, Romania, USA, Iraq, Russia	low-income group	Depression schizophrenia	Accessibility Affordability Government Rules & Policy	mHealth	Incorporates behavioral activation and mindfulness techniques based on psychological research. Uses data analytics to monitor and track mental health symptoms and outcomes.	Develops intuitive user interfaces for enhanced user engagement. Integrates sensor technologies and wearables for real-time health data collection.

Table 2. Continued
Data extraction from previous study

Study, author, year	Country	Group	Type of disorder	Influencing factors	DMH tools	Applied science perspective	Engineering technology perspective
Lee *et al.,* 2020 [18]	Urbana	low-income group	Stress, mental illness	Cultural & Sensitivity Accessibility	Chatbox	Utilizes cognitive-behavioral therapy (CBT) principles for automated mental health support. Integrates psychological theories to personalize interactions based on user data and responses.	Employs natural language processing (NLP) to understand and respond to user inputs. Uses machine learning algorithms to improve responses and tailor interventions over time.

3.1 Reviewed Paper 1: Sultana and Pagan [15]

This study focuses on the low-income population in the United States, addressing depressive and anxiety disorders. The key influencing factors identified in this study are accessibility and bilingual communication, which are crucial for ensuring that mental health services are available and understandable to all segments of the population. Multilingual Support is needed for communication using the tools use as DMH for mental health care services to make the user understand about the instruction and how to manage the tool for treatment. This supports its important to ensure the user comfortable with the dominant language of the region. The language must be tailored with the participant home country language to make the services more effective and relevant. The study mention that when coordinating the mental health care to patients or providers and the patient outreach differed in the context of non-English speaking populations. Low English literacy impacted the communication between the patient and provider and should enhanced the tele-health experience by accommodating patient with bilingual. The study mentioned that the few individuals living with mental disorders around the globe have access to mental health care, and the access to a mobile phone. Digital technology hold promises for improving mental health care services and their access.

The ability to use a phone with audio or video helps low-income group make up for technological obstacles like bandwidth limitation and internet access. Telehealth, on the other hand, can increase low-income persons underserved access to mental health care because of resources constraints. Intervention in telehealth can help reduce social determinants of health, including transportation barriers, access to technology and other socioeconomic disadvantages. The use of mHealth and telehealth platforms allows for the application of therapeutic frameworks such as Cognitive Behavioural Therapy (CBT) and psychodynamic therapy in remote consultations. These platforms leverage real-time analytics to assess and improve the quality of care provided. From an engineering technology perspective, the study highlights the use of cloud computing and encryption technologies to ensure secure real-time communication, thus maintaining data privacy and confidentiality. While telehealth makes it possible to consult a mental health professional virtually, the results of this research do not offer enough evidence to support the nation that telehealth should completely

replace in person mental health care. The potential of telehealth to address enduring obstacles to care access, such as stigma and cost, that still afflict low-income communities is constrained.

3.2 Reviewed Paper 2: Koley et al., [16]

This paper explores mental health issues within low-income groups in Bangladesh, emphasizing the importance of accessibility and affordability. In this paper mentioned that the stakeholders assert that improved mental health care service accessibility and availability are made possible in large part by digital mental health care. It reported that using digital platforms to seeks treatment made it simple to guarantee the service providers were available right away. Affordability is one the most important factors that can encourage patient to use the services of digital mental health. Internet accessibility and affordability must be the reason people join the program or service to prevent mental disorder. Applying technology in mental health service are often more cost-effective compare than traditional in-person therapy that makes them more accessible to individuals with low cost. This paper reviewed proof that online and mobile will be remotely prevent and treat mental disorder in low-income group. From these review paper also mention that the 49 studies were identified about the feasibility and acceptability evaluation of mental health care services. Its promising the effectiveness of online intervention such, text messaging, and telephone to support the services.

Digital Mental health platform gave the flexibility in terms of timing and location that give a convenience services without barrier and can reach the mental health care services anytime. According to this study reviewed, the usage of social media platform and digital media was increase during pandemic and reported more than 2.1 billion global social media users per day. Digital media bring the potential across geographic distances to reach a large population in a very short time frame. The mental health content from the Digital media-based has been proved to seeking behaviours information among the population that creates significant benefit to identify user information and mental health. The balanced approach should be implied which addresses the individual clinical needs and the social determinants of mental health for people with mental health disorders.

The intervention of mental health that fail to take account of mental health social determinants will fail to achieve their future impact, especially those worsened by COVID-19. In this balanced approach mental health can be reframe as a common and prioritized aspiration in low-income groups and all countries worldwide. These study results show that the Digital Media Platform not only can extract the mental health information from users but it also can stand as promotion platform as to bring the awareness of mental health care services and provide the training for self-help intervention in Bangladesh by increase network coverage. By leveraging social support and community psychology principles, these platforms create impactful mental health campaigns grounded in psychological theories. Engineering technologies play a pivotal role here, with data analytics being used to measure engagement and track the impact of interventions. Platform algorithms further aid in identifying and addressing mental health concerns in real-time, demonstrating a sophisticated use of technology to enhance mental health outcomes.

3.3 Reviewed Paper 3: Naslund et al., [17]

Naslund *et al.,* [17] take a broader geographical approach, studying low-income groups across multiple countries, including India, Malaysia, South Africa, China, and several others. The study addresses depression and schizophrenia, with influencing factors such as accessibility, affordability, and government policies. Digital technology may present opportunities to engage with people who may not have access to traditional healthcare or who are reluctant to seek assistance because of

stigma, distance from home, or financial difficulties. Online self-help programmes offer discreet and anonymous ways to get help by giving users rapid access to materials and encouraging online groups. Mobile accessibility given the widespread use of mobile devices, ensuring that digital mental health resources are mobile-friendly can increase engagement among low-income individuals who might primarily access the internet via smartphones.

Globally, most people who suffer from mental illnesses have access to a cell phone, but very few have access to mental health care. Digital Technology has the potential to enhance both the quality and accessibility of mental health services. Since many people cannot pay the expenditures connected with technological access, affordability is a crucial factor. For many people, the cost of adopting new technology will prevent them from using them. This encompasses the most destitute environments as well as people living in remote locations without access to reliable network coverage or energy. People without access may also reside in areas where access to mobile phones and the internet is restricted by government regulations and stringent oversight of the telecoms industry. Government rules contribute to access restrictions, which makes the problem worse for some groups of people. These rules, which are typified by strict supervision of the telecom sector, make the problem of restricted access for particular demographics worse.

Government regulations significantly contribute to access restrictions, which exacerbates the difficulties experienced by people who already lack access as a result of different socioeconomic reasons. This paper mention that Virtual therapy was the commonly used telehealth intervention and give effective primary care setting, although this as seen as supplement of therapy and need direct face to face and play as mediating patient with the accommodation. Mheath is a new way to reach, assist and treat people with mental illnesses as a result of the extraordinary expansion of internet and mobile phone use in many low-middle income nations. In this paper reported 9 previous studies that shown in several low-income nations in Africa, Central America and South Asia, more than 80% of people have mobile phone connection. The use of mHealth tools incorporates behavioural activation and mindfulness techniques based on psychological research, alongside data analytics for monitoring symptoms and outcomes. Engineering advancements are evident in the development of intuitive user interfaces for better engagement and the integration of sensor technologies and wearables for real-time health data collection. This combination of applied science and engineering technology underscores the potential for scalable and effective mental health interventions.

3.4 Reviewed Paper 4: Lee et al., [18]

Lee *et al.,* [18] focus on the urban low-income group, addressing stress and general mental illness. The study identifies cultural sensitivity and accessibility as critical factors. This reviewed paper's findings emphasise how crucial it is to include accessibility elements in chatbot designs in order to increase inclusion and usefulness. Determine the most important areas for improving chatbot accessibility through user input and iterative design iterations. These include giving customisable interfaces, providing alternate communication channels (like text-to-speech), and making sure that the chatbot is compatible with assistive devices (like screen readers). The results highlight how important it is to overcome accessibility issues in order to maximise chatbots' influence and reach in mental health services. Chat-bot are used for revealing personal or sensitive information to others and from this self-disclosure people can release their stress. Since the conversation via Chatbot are not included human people would share some personal disclosure and they understand the data will be processed by the machine before send to mental health professionals (MHPs). Nevertheless, it is always challenging for MPH to receive people’s self-disclosures and one example of the sample from

the study, it is found after offer the free service to college students, they still incline to self-disclose to professionals or to seek mental health care.

In this article focused on Chatbot as DMH tools that potentially improve people's mental health as artificial intelligence develops since they encourage people to express their thoughts and emotions. The utilization of chatbots provides automated mental health support based on cognitive-behavioural therapy (CBT) principles. These chatbots personalize interactions using psychological theories, which are tailored based on user data and responses. Engineering innovations, such as natural language processing (NLP) and machine learning algorithms, are employed to understand user inputs and improve responses over time. This approach highlights the potential for AI-driven mental health tools to provide scalable and personalized support. In summary, these studies collectively illustrate the significant impact of DMH tools in managing mental health disorders among low-income populations. The applied science perspectives emphasize the use of established therapeutic frameworks and psychological principles to enhance the efficacy of these tools. Meanwhile, engineering technology perspectives focus on leveraging advanced technologies such as cloud computing, data analytics, NLP, and machine learning to ensure secure, effective, and personalized mental health care.

4. Discussion

4.1 Integration of Psychological Theories in Digital Mental Health Interventions

Digital mental health interventions are increasingly integrating established psychological theories to enhance their effectiveness and tailor treatments to individual needs. One prominent example is the incorporation of Cognitive-behavioural therapy (CBT) principles into mobile health (mHealth) apps and chatbot interfaces. CBT, a well-established therapeutic approach, focuses on identifying and modifying negative thought patterns and behaviours explained by Beck *et al.,* [19]. By offering structured therapeutic exercises and cognitive restructuring techniques, these interventions aim to empower users in managing their mental health more effectively. Research demonstrates the efficacy of integrating CBT into digital platforms. For instance, CBT-based mobile apps provide users with tools for self-monitoring, mood tracking, and guided exercises that simulate therapeutic sessions justified by Proudfoot *et al.,* [20]. These apps often include interactive features that encourage users to practice CBT techniques in their daily lives, promoting long-term behavioural changes and symptom management.

Moreover, the scalability and accessibility of CBT-based digital interventions are notable advantages. Unlike traditional face-to-face therapy, which may be limited by geographical and financial barriers, digital platforms can reach a broader audience at a lower cost clarified by Kazdin & Blasé [21]. This scalability allows for widespread dissemination of evidence-based psychological interventions, potentially improving mental health outcomes on a population level. The integration of psychological theories, such as CBT, into digital mental health interventions represents a significant advancement in enhancing treatment accessibility and effectiveness. By leveraging technology to deliver structured therapeutic content and personalized support, these interventions empower individuals to actively participate in their mental health care, thereby addressing barriers to traditional therapy and improving overall well-being.

4.2 Role of Data Analytics and Personalization

Data analytics plays a crucial role in enhancing the personalization and effectiveness of digital mental health interventions. These interventions leverage continuous monitoring of user data,

including mood trends, behaviour patterns, and treatment adherence, to tailor interventions in real-time. By analysing user-generated data, digital platforms can adapt content and support strategies to meet individual needs and preferences justified by Faurholt *et al.,* [22]. Real-time data analytics enable proactive intervention strategies. For example, predictive analytics algorithms can identify early warning signs of deteriorating mental health based on changes in user behaviour and mood patterns extracted by Torous *et al.,* [23] study. This capability allows healthcare providers to intervene promptly, potentially preventing crises and improving treatment outcomes. Personalized interventions supported by data analytics also enhance user engagement. By delivering targeted interventions that resonate with individual preferences and needs, digital platforms can increase user motivation and adherence to treatment protocols justified by Faurholt *et al.,* [22]. Interactive features, feedback mechanisms, and goal-setting tools further optimize user engagement, fostering a collaborative approach to mental health management. Furthermore, data-driven insights contribute to the continuous improvement of digital interventions. By analysing aggregated data on user outcomes and experiences, developers can refine intervention strategies and optimize resource allocation, thereby enhancing the overall effectiveness and scalability of mental health services. The integration of data analytics into digital mental health interventions enhances personalization, engagement, and treatment outcomes. By leveraging real-time data to deliver tailored interventions and proactive support, these interventions demonstrate the potential to revolutionize mental health care delivery and improve patient well-being.

4.3 Engineering Technology in Telehealth Platforms

Telehealth platforms leverage engineering innovations to facilitate remote consultations and broaden access to mental health services. Secure video conferencing systems ensure confidentiality, enabling synchronous interactions between patients and healthcare providers across geographical distances. Cloud-based solutions enhance scalability and reliability, supporting seamless integration into existing healthcare infrastructures and improving operational efficiency. Telehealth platforms utilize video conferencing and digital communication tools to facilitate remote consultations with mental health professionals. This approach is grounded in the principles of telemedicine, which aim to increase access and reduce the burden of travel for patients. Studies by Hilty *et al.,* [24] have explained that telehealth can be as effective as in-person therapy for a variety of mental health conditions. The engineering behind telehealth platforms involves the integration of high-definition video and audio technologies, secure communication protocols, and robust data encryption. These platforms must comply with healthcare regulations and standards to ensure patient confidentiality and data protection. Ongoing technological advancements are enhancing the reliability and scalability of telehealth services explained by Shore *et al.,* [25].

4.3 Impact of AI and Chatbot Technology

Artificial intelligence (AI) and chatbot technologies utilize natural language processing (NLP) and machine learning algorithms to simulate human-like interactions and provide immediate mental health support. AI-driven chatbots offer personalized responses based on user input, triaging mental health concerns effectively. These technologies enable chatbots to understand and respond to a wide range of user queries, improving their accuracy and effectiveness over time. Continuous advancements in AI and machine learning are enhancing the capability of chatbots to provide personalized and scalable mental health support justified by Laranjo et al., [26]. Chatbots in mental health leverage cognitive-behavioural therapy (CBT) principles to provide immediate psychological

support. Studies have shown that these AI-powered tools can simulate human-like interactions, offering real-time counselling and crisis intervention. Chatbots analyse user inputs to tailor their responses, applying psychological theories to manage symptoms of anxiety, depression, and other mental health conditions explained by Fitzpatrick *et al.,* [27]. This technology enhances accessibility to mental health resources, particularly in underserved communities, thereby filling gaps left by traditional healthcare services.

4.4 Advantages of myHealth Applications

mHealth applications incorporate evidence-based therapeutic techniques, such as mindfulness, relaxation exercises, and behavioural activation. These apps track user behaviour and mood patterns, providing insights and feedback to promote mental well-being. Research has demonstrated that mHealth apps can effectively reduce symptoms of mental health disorders and improve overall psychological resilience enlightened Firth *et al.,* [28]. The development of mHealth applications involves the integration of user-friendly interfaces, secure data storage, and seamless connectivity with other digital health tools. Engineering efforts focus on ensuring these apps are accessible across different devices and platforms, making mental health support available anytime and anywhere. Advances in mobile technology and app development frameworks are critical to the success and adoption of mHealth solutions justified by Torous *et al.,* [23].

4.5 Role of Social Media Platforms in Mental Health

Social media platforms serve as powerful tools for mental health advocacy and community support. Campaigns and peer support groups on platforms like Facebook and Instagram reduce stigma, promote awareness, and foster supportive networks. Analytics measure the impact of these initiatives, providing insights into audience engagement and effectiveness in reaching diverse demographics. Social media platforms are used to create supportive online communities and provide psychoeducation. Applied science research has shown that these platforms can offer significant benefits for mental health, including peer support, information dissemination, and stigma reduction. Social media interventions are designed based on principles of social support and community psychology extracted by Naslund *et al.,* [18]. Engineering efforts focus on developing algorithms to detect and respond to mental health-related posts, ensuring timely intervention and support. Social media platforms employ machine learning and data analytics to monitor user interactions and identify individuals at risk. These technologies enable the creation of responsive and interactive mental health resources within social media environments justified by Guntuku *et al.,* [29].

4.6 Cost-Efficiency and Resource Optimization

Digital mental health interventions are increasingly recognized for their cost-effectiveness compared to traditional in-person care models. By leveraging cloud computing and virtualization technologies, these interventions minimize infrastructure costs while enhancing scalability and resource allocation explained by Hollis *et al.,* [30]. For instance, cloud-based solutions allow for the storage and processing of large datasets efficiently, reducing the need for physical infrastructure investments. Economic analyses underscore the long-term financial benefits of digital interventions in mental health care. A study by Hollis *et al.,* [30], found that telepsychiatry and online therapy services significantly lowered direct healthcare costs by reducing hospital admissions and emergency room visits. This cost-saving potential makes digital interventions sustainable options for enhancing

mental health services, particularly in resource-constrained settings where traditional healthcare infrastructure may be lacking.

Furthermore, virtualization technologies enable mental health providers to reach a broader audience without geographical constraints, thereby optimizing service delivery and reducing operational costs explained by Hollis *et al.,* [30]. These technological advancements not only improve efficiency but also contribute to the overall affordability and accessibility of mental health care services. Supporting this, Donker *et al.,* [31] showed that internet-based mental health interventions are generally cost-effective, reducing both direct and indirect mental health care costs. These findings emphasize the financial viability of DMHIs, particularly for low-income groups. Mohr *et al.,* [32] identified key issues in digital mental health research and suggested integrating scalable digital solutions with existing healthcare systems to improve cost-efficiency and resource utilization. Naslund *et al.,* [17] reviewed digital technologies for mental health in low- and middle-income countries, finding these tools significantly reduce healthcare costs while expanding access to care. DMHI offer compelling cost-efficiency benefits through the adoption of cloud computing and virtualization technologies. These innovations not only reduce healthcare expenditures but also enhance scalability and resource optimization, making them sustainable solutions for improving mental health outcomes globally.

4.7 Ethical Considerations and Data Privacy

Maintaining robust cybersecurity measures and adhering to data protection regulations are critical in fostering trust and confidentiality in digital mental health interventions. The integration of ethical frameworks ensures that patient data is managed responsibly, respecting informed consent and data ownership rights explained by Huckvale *et al.,* [33]. Ethical guidelines also mitigate risks associated with data breaches and unauthorized access, safeguarding patient privacy in telehealth and mobile health (mHealth) applications. According to Huckvale *et al.,* [33], ethical considerations in digital mental health include transparency in data collection practices, secure data storage, and encryption protocols to protect sensitive information. These measures are essential for building patient trust and maintaining the integrity of mental health services delivered via digital platforms.

In addition, regulatory compliance with data protection laws, such as the General Data Protection Regulation (GDPR) in Europe or the Health Insurance Portability and Accountability Act (HIPAA) in the United States, ensures that patient confidentiality is upheld throughout the treatment process justified in the same study by Luxton *et al.,* [34]. By adhering to ethical and legal standards, digital mental health interventions can effectively address privacy concerns and promote patient safety in online healthcare environments. In summary, ethical considerations and data privacy safeguards are indispensable in the development and implementation of digital mental health interventions. By prioritizing patient confidentiality and data security, these interventions can build trust among users and healthcare providers, thereby enhancing the adoption and effectiveness of telehealth and mHealth applications.

4.8 Impact on Accessibility and Equity

Digital mental health interventions play a crucial role in bridging geographical barriers and improving accessibility to mental health services, particularly in underserved communities. Factors such as accessibility, communication, affordability, cultural sensitivity, and supportive government policies are pivotal in facilitating the uptake of these interventions among low-income groups found by Chang *et al.,* [35]. Mobile technologies and telehealth platforms extend the reach of mental health

services to rural and remote areas, where access to traditional healthcare facilities may be limited explained in the same study by Chang *et al.,* [35]. For example, telepsychiatry programs have been instrumental in providing psychiatric consultations and therapy sessions remotely, overcoming geographic distances and transportation challenges. Moreover, Chang *et al.,* [35] also explained digital interventions promote cultural sensitivity by tailoring mental health resources to diverse cultural backgrounds and languages, thereby enhancing engagement and treatment adherence. Collaborations between healthcare providers, community organizations, and policymakers further support the integration of digital technologies into healthcare systems, ensuring equitable access to mental health care services. Case studies highlight the transformative impact of digital mental health interventions on accessibility and equity.

For instance, initiatives that combine mobile apps with community outreach programs have effectively reduced disparities in mental healthcare delivery, improving outcomes for marginalized populations found in Chang *et al.,* [35] study. These efforts underscore the potential of technology to address healthcare disparities and promote health equity on a global scale. Supporting this, Yellowlees *et al.,* [36] demonstrated that telehealth can significantly reduce healthcare access disparities by providing mental health services to remote and rural populations. Additionally, Patel *et al.,* [37] emphasized the importance of culturally sensitive digital interventions in improving mental health outcomes in diverse communities. These findings underscore the potential of DMHIs to enhance accessibility and equity in mental healthcare. Overall, DMHIs enhance accessibility and equity by leveraging mobile technologies and telehealth platforms. By addressing socio-economic barriers and promoting cultural sensitivity, these interventions help reduce disparities in mental health care access and improve overall health outcomes for underserved populations.

4.9 Scalability and Sustainability

Scalability and sustainability are critical considerations in the implementation of digital mental health interventions to accommodate growing demand and diverse user needs. Continuous innovation and stakeholder engagement are essential for developing scalable solutions that can be integrated into existing healthcare systems effectively extracted by Fortney *et al.,* [38]. Collaboration with policymakers and healthcare providers is crucial for ensuring interoperability and sustainable integration of digital technologies into mental health care delivery enlightened by Fortney *et al.,* [38]. By aligning technological advancements with healthcare priorities and regulatory frameworks, stakeholders can optimize the impact of digital interventions on mental health outcomes. For example, scalable telepsychiatry programs have been successfully implemented in various healthcare settings, demonstrating the feasibility of expanding mental health services remotely. These programs leverage digital platforms to deliver psychiatric consultations, therapy sessions, and medication management, thereby increasing access to care for diverse populations. Furthermore, in the same study by Fortney *et al.,* [38], economic analyses highlight the long-term benefits of scalable digital interventions, including reduced healthcare costs and improved patient outcomes. Cloud-based solutions and virtualization technologies enhance operational efficiency, allowing mental health providers to meet growing demand without compromising service quality. Scalability and sustainability are essential for maximizing the impact of digital mental health interventions on population health.

By fostering innovation and collaboration, stakeholders can create scalable solutions that enhance mental health care access, improve treatment outcomes, and promote long-term sustainability in healthcare delivery systems. Mohr *et al.,* [32] emphasize integrating digital tools into routine care to ensure sustainability, suggesting that leveraging existing healthcare infrastructure

and training providers can facilitate adoption. Additionally, Yellowlees *et al.,* [36] discuss how standardized protocols and team collaboration can effectively scale telehealth services. DMHI hold immense promise in revolutionizing mental health care delivery by leveraging technology to enhance accessibility, affordability, and quality of services. By addressing cost-efficiency, ethical concerns, accessibility barriers, and scalability challenges, stakeholders can work towards a future where equitable access to effective mental health care is a reality for all. Continued research, policy support, and investment in technological innovation are crucial for realizing the full potential of digital interventions in improving mental health outcomes globally.

5. Conclusions

This paper acknowledges the preference of young adults in lower economic categories for utilizing social media, suggesting the potential to leverage these platforms to expand mental health support. However, it is crucial to recognize the limitations of this research, including the specific time period and databases used, as well as the focus on English-language publications. These factors may constrain the comprehensiveness and generalizability of our findings. To enhance the understanding of the efficacy of Digital Mental Health (DMH) therapies, future research should consider broader time frames, diverse databases, and multilingual approaches. By addressing these constraints, researchers can provide a more nuanced exploration of how DMH interventions can effectively serve diverse populations, including those with limited economic resources. Moreover, future studies can play a pivotal role in improving access to and effectiveness of mental health services for low-income individuals. By adopting comprehensive research strategies that encompass longer time spans, utilize diverse linguistic resources, and incorporate a wider array of databases, researchers can better capture the nuanced impacts of DMH interventions across different socio-economic contexts.

In conclusion, while this study highlights the potential of social media in enhancing mental health support among young adults from lower economic backgrounds, it also underscores the need for future research to address methodological limitations. Embracing broader research scopes and methodological diversity will not only enrich our understanding of DMH efficacy but also contribute to more inclusive and effective mental health care strategies for vulnerable populations.

Acknowledgement

This research was funded by a grant from Ministry of Higher Education of Malaysia (FRGS Grant MMUE/220034). This work was supported by a grant from the National Program for Research of the National Association of technical Universities-GNAC ARUT 2023.

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